Congressional Notification Profile
DE-PS26-02NT41369

UNIVERSITY COAL RESEARCH PROGRAM, CORE PROGRAM
University of Colorado

Background and Technical Information:

The University of Colorada proposes to prepare a type of membrane, a zeolite membrane, to better recover hydrogen from coal gasification. The university plans to address the problem that membranes are not mechanically and chemically stable, and cannot provide a highly selective separation of hydrogen from other light gases at high temperatures and pressures. Success with this membrane will also allow it to be used in other types of membrane reactor applications, such as dehydrogenation reactions.

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Congressional District: CO 2nd County: Boulder

Financial Information:

Length of Contract (months): 36
Government Share: $200,000
Total value of contract: $200,000

DOE Funding Breakdown:
Funds: FY 2002 $200,000

ABSTRACT

The objective of the research proposal is to prepare zeolite membranes that will be capable of highly selective H_2 separation from other light gases (CO, CO_2, H_2O) for use in catalytic membrane reactor applications related to coal conversion and gasification. These zeolite membranes have the potential to operate over a wide temperature and pressure range and in chemically challenging environments where existing technologies are inefficient or unable to operate.

The approach will address the two fundamental properties associated with membrane separations: flux and selectivity. To date, membranes have not been developed that are mechanically and chemically stable and can provide a highly selective separation of H_2 from other light gases at elevated temperatures and in chemically challenging conditions associated with coal gasification. At elevated temperatures, the gas flux will be inversely proportional to the membrane thickness. We propose to synthesize thinner, defect-free zeolite membranes through the use of a covalent linking method to attach seed crystals to the support prior to the actual synthesis.

Initial results with B-ZSM-5 zeolite membranes have shown that we can get up to a five-fold increase in flux with this approach. To obtain high selectivity for this separation at elevated temperatures, the membrane must be capable of molecular sieving. The membrane will have to discriminate between molecules that are approx. 0.3 – 0.4 nm in size and 0.1 nm or less in size difference. To accomplish this sieving, we propose to synthesize small pore zeolite membranes that have pores in this size range [Type A (0.42 nm) and chabazite (0.38 nm)]. We will then post-treat them to systematically reduce the pore size and the non-zeolite pores (grain boundaries) using three different methods: CVD (chemical layer deposition), ALD (atomic layer deposition) and photopolymerization. These post-treatment procedures should give us the flexibility to "tune" the pore size and resulting selectivity with high precision.

This approach will also allow us to use these membranes for other types of membrane reactor applications such as dehydrogenation reactions where the molecular size difference between H_2 and the other components is larger.

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